Remarks

Claims 1 to 9 are pending in this application.

The examiner is requested to favorably reconsider the objection to the Abstract of the Disclosure. The use of the term "comprising" does not render the abstract unclear. The term does not appear to be of the objectionable type contemplated by the MPEP. Favorable reconsideration is solicited.

The examiner is requested to favorably reconsider the objection to the disclosure proviuef the foregoing amendment to the specification. Appropriate captions have been

The examiner is [illegible] to favorably reconsiderthe objection to the specification in view of the foregoing amendment. The expression $100\ m^3/m^3$ now has antecedence in the specification.

The examiner is requested to favorably reconsider the rejection of the claims under 35 U.S.C. 112, second paragraph in view of the foregoing amendment and the following remarks. Process claim 1 has been amended so as to include the feature that the pure ethylene oxide taken off at the top distillation column contains 4 ppm or less formaldehyde. Support is given on page 3, first paragraph of the description, saying that it is an object of the invention to produce ethylene oxide substantially free of formaldehyde, i. e. containing only approximately 4 pprn or less formaldehyde, and page 3, second paragraph, saying that this object is achieved according to the invention. Claim 2 is a proper dependent claim in as much as it refers to and further limits the base claim with respect to the characteristics of of the distillation apparatus. The reference in claim 1 to " a mixture is obtained which

contains less than 5% by weight ethylene oxide" by the examiner is not understood. The claim simply and clearly describes that which occurs during the distillative step. Nothing further is required. A person of ordinary skill would know how to recover the prescribed concentration, and the claims need not be replete with that which is known to those of ordinary skill in the art to whom the languge is directed. Similarly, those of ordinary skill would understand the operation of a distillation apparatus to which the base claim refers, including the taking off of a bottom phase. The parenthetical expressions have been replaced. Claim 10 has been cancelled. The objectionable language has been cancelled at claims 6 and 8, as being superfluous. The applicants respectfully urge that the claims as amended now point out the disclosed invention with the requisite statutory particularity. That some claims describe the instrumentalities implied but not recited in the process already described in the base claim does not render them indefinite. Favorable reconsideration is solicited.

Process claims 1 and 3 have been amended to include the feature that the pure ethylene oxide taken off at the top distillation column contains 4 ppm or less formaldehyde. Support is given on page 3, first paragraph of the specification , wherein it is noted that an object of the invention is to produce ethylene oxide substantially free of formaldehyde, i. e. containing only approximately 4 pprn or less formaldehyde, and page 3, second paragraph, wherein it noted that this object is achieved according to the invention.

Claims 1 to 10 (now 1 to 9) stand rejected under 35 U.S.C. 103(a) as being unpatentable over EP '323 in view of Coffey or Gilman et al. This rejection is traversed.

It is an object of the present invention to provide a process for purification of ethylene oxide by distillation which yields a bottom product having a low ethylene oxide content and,

at the same time, a top product having a very low formaldehyde content. This object is achieved by introducing the feed mixture at the minimum height above the bottom specified in claim 1and, alternatively, in claim 3. The ethylene oxide content of the bottom phase can be controlled by adjusting the usual regulating variables which determine the separation efficiency of a distillation column. Such regulating variables are the respective flows of feed, top fraction withdrawal, bottom fraction withdrawal, the reflux ratio and the heat input. Adjusting said variables leads to an equilibrium temperature distribution within the distillation column, which mirrors the corresponding equilibrium concentration distribution and thus the separation efficiency of the column. Adjusting said variables in order to attain a bottom product with the specified low ethylene oxide content is within ordinary skill in the art. However, the present invention resides in introducing the feed mixture at a specific minimum distance above the bottom, by which measure a very pure top prod- uct having a very low formaldehyde content and, at the same time, a bottom product having a low ethylene oxide content can be obtained. The low ethylene oxide content of the bottom product corresponds to a high equilibrium temperature at the bottom, since the bottom product mainly consists of water. Formaldehyde, which is predominantly present in the form of methylene glycol in the influent aqueous mixture, is released in the bottom phase as a result of the high temperatures, owing to the equilibrium lying on the side of monomeric formaldehyde at high temperatures. However, by adding the feed at the specified minimum distance from the bottom, the formaldehyde content of the top product can be kept very low, which is an unexpected result.

It would not be obvious to a person of ordinary skill to obtain a top product which is very low in formaldehyde by taking the measures as set out in claims 1 and 3, i. e.

introducing the feed at a specific minimum distance above the bottom. Delannoy (EP 322 323 = US 4,966,657) discloses a process for separating ethylene oxide from formaldehyde and acetaledehyde in contaminated ethylene oxide in a reflux column. According to Delannoy, a bottom product is obtained containing water and ethylene oxide in amounts corresponding, on a weight basis, to 0.15 to 3 times the weight of water, i. e. from 15 to 75 % by weight of ethylene oxide. The high ethylene oxide content of the bottom phase is deliberately chosen, since there is no increased release of monomeric formaldehyde from the bottom phase, owing to the low temperatures corresponding to the high ethylene oxide content. However, the formaldehyde concentration in the top product is still much higher than according to the present invention, i. e. from 0.0025 wt.% (= 25 ppm) to 0.0015 wt.% (= 15 ppm), as stated in column 3, lines 63 and 64 of Delannoy.

According to Coffey, a bottoms product containing from about 0.5 to 20 wt.% ethylene glycol and a top product containing from about 2 to 10 ppm formaldehyde is obtained. However, this result is achieved by carrying out an extractive distillation, i. e. by washing the column using wash water that may be composed of fresh water and recycled aqueous bottom liquid or entirely of recycled liquid, see column 7, lines I I to 17. According to the presently claimed invention, no such extractive distillation is carried out.

Delannoy in view of Coffey cannot render the present invention obvious, since Coffey uses an extractive distillation in order to achieve the low formaldehyde content in the top product. No hint is given in Coffey that the same goal can be achieved without using an extractive distillation by simply conducting the process as set forth in instant claims 1 and 3. i. e. introducing the feed at a specific minimum height. The same holds for Gilman. According to Gilman, in order to achieve the low formaldehyde content of 5 ppm in the top

product, an extractive distillation is carried out using water as an extractive agent, see col. 2, lines 38 to 49 and claim1 of Gilman. Gilman teaches away from the claimed invention, disclosing at column 2, lines 38 to 40, that an ethylene oxide containing 50 ppm is obtained using the process according to figure 1, i. e. without adding water as an extractive agent.

For all of the foregoing reasons, the applicants respectfully urge that the presently claimed invention is patentable, and a Notice of Allowance is solicited.

Please find attached a check for $390.00 for the two month extension of time fee.

To the extent necessary, applicant(s) petition for an Extension of Time under 37 CFR 1.136. Please charge any shortage in fees due in connection with the filing of this paper, including Extension of Time fees to Deposit Account No. 11-0345. Please credit any excess fees to such deposit account.

Respectfully submitted,
KEIL & WEINKAUF

Henry R. Jiles
Reg. No. 32,677

1101 Connecticut Ave., N.W.
Washington, D.C. 20036
(202)659-0100

HRJ/mks

Current claims in BESSLING et al. Serial No. 09/341,921 OZ 0050/47699

1. A process for purification of ethylene oxide by distillation, comprising the step in which

- an aqueous mixture comprising ethylene oxide, formaldehyde and at least 5 % by weight of water is introduced via a feed into a distillation apparatus comprising at least one distillation column, the mixture being introduced at a height above the bottom of at least 8 theoretical stages,

-pure ethylene oxide containing 4 ppm or less formaldehyde, is taken off at the top and

- in the bottom phase, a mixture is obtained which contains less than 5 % by weight of ethylene oxide.

2. A process for purification of ethylene oxide by distillation, comprising the step in which

- an aqueous mixture comprising ethylene oxide, formaldehyde and at least 5 % by weight of water is introduced via a feed into a distillation apparatus comprising at least one packed column which contains a structured or bulk packing and has a specific mass transfer area A, the mixture being introduced at a height above the bottom of at least x^{min}, in m, which, for a given specific mass transfer area A, in m^2/m^3 , is given by the equation $x^{min} = 5.5\ m - A \cdot 0.006\ m^2$,

-pure ethylene oxide containing 4 ppm or less formaldehyde, is taken off at the top and

- in the bottom phase a mixture is obtained which contains less than 5% by weight of ethylene oxide.

3. A process as claimed in claim 2, wherein the aqueous mixture is introduced via the feed at a height of from $1.5x^{min}$ to $7x^{min}$.

4. A process as claimed in claim 2, wherein the specific mass transfer area A is in the range from 100 m^2/m^3 to 500 m^2/m^3.

as of February 26, 2001

5. A process as claimed in claim 1, wherein the aqueous mixture comprising ethylene oxide, formaldehyde and at least 5% by weight of water is introduced via a feed into a distillation apparatus comprising at least one plate column, the mixture being introduced at a height above the bottom of least 12 plates.

6. A process as claimed in claim 1 which further comprises the step in which further mixture, principally comprising water, is additionally introduced via a feed line at a height of at least one theoretical stage or plate above the feed of the aqueous mixture.

7. A process as claimed in claim 1, wherein flame-arresting packings are used in the distillation apparatus.

8. A process as claimed in claim 1, wherein a distillation apparatus is used in which, between the feed and the bottom, there is installed a side take-off via which is taken off a mixture which is enriched with acetaldehyde in comparison with the influent aqueous mixture.

9. A process as claimed in claim 1, wherein a distillation apparatus is used in which an intermediate reboiler is situated between the feed and the bottom.